

Virginia Rich • vrich@email.arizona.edu

Postdoctoral Researcher • University of Arizona • Ecology and Evolutionary
Biology Department • Tucson, AZ 85721 • 617-694-5087

RESEARCH INTERESTS

I am interested in understanding the dynamic link between microbial communities and global biogeochemistry. My postdoctoral and longer-term research goal is to map complex microbial-ecosystem interactions, and to work with collaborators to incorporate this knowledge into predictive modelling frameworks to allow for practical applications as well as comprehensive ecosystem studies.

EDUCATION

Massachusetts Institute of Technology, Joint Program with the Woods Hole Institute of Oceanography

Ph.D. September 2008

Co-advisors: Ed DeLong, MIT, and George Somero, Stanford

Thesis: "Development of a "Genome-Proxy" Microarray for Profiling Marine Microbial Communities, and its Application to a Time Series in Monterey Bay, California". I developed a novel microarray platform to track the changes in marine microbial communities and applied it across environmental gradients, in concert with metagenomic analyses.

University of California at Berkeley

B.A. Molecular and Cell Biology, emphasis Genetics

B.A. Integrative Biology, graduated 1998

PUBLICATIONS

Rich, V, K. Konstantinidis, DeLong EF. Design and testing of "genome proxy" microarrays to profile marine microbial communities. *Environmental Microbiology*, 10: 506-521.

Preston, CM, Suzuki M, **Rich V**, Heidelberg J, Chavez F, DeLong EF. Detection and distribution of two novel form II RuBisCos in the Monterey Bay. *Manuscript in preparation*.

DeLong EF, Preston CM, Mincer T, **Rich V**, Hallam SJ, Frigaard NU, Martinez A, Sullivan MB, Edwards R, Brito BR, Chisholm SW, Karl DM. 2006. Community genomics among stratified microbial assemblages in the ocean's interior. *Science*. 311:496-503.

Horz, H-P, **Rich V**, Avrahami S, and Bohannon BJ. 2005. Methane-oxidizing bacteria in a California upland grassland soil: diversity and response to simulated global change. *Applied and Environmental Microbiology*. 71(5): 2642-2652.

POST-BACCALAUREATE RESEARCH EXPERIENCE

Massachusetts Institute of Technology, and the Monterey Bay Aquarium Research Institute (MBARI), DeLong Lab

Graduate Student, 01/04 – 09/08

Question: How do marine microbial communities change across environmental gradients of light, temperature, and nutrients?

1st Approach: To enable higher-throughput tracking of marine microbes, I developed a novel microarray platform targeting uncultivated, dominant microbes in environments of interest. I am currently applying this array to understanding seasonal and depth distributions of marine microbial communities in Monterey Bay, CA, where there is an associated long-term physical-, chemical- and biological- monitoring program run by MBARI. This work represents the current focus of the Monterey Bay Microbial Observatory.

Findings: This microarray is able to track clusters of micro-organisms within >85% average nucleotide identity of those targeted, with a current limit of detection of 1000 cells/ml seawater. Microarray signal is linearly related to target cell concentration with an R^2 of 0.999 across six orders of magnitude. The first manuscript was published in *Environmental Microbiology*, the second is in preparation

2nd Approach: As part of a large collaborative effort to explore metagenomics data from microbial communities through the water column at the Hawai'i Ocean Time Series Station ALOHA, I examined the depth distribution of specific marine microbes.

Findings: Pelagic microbial communities are stratified with depth; the complements of organisms and of metabolic genes are differentially distributed through the water column. This work was published in *Science*.

Stanford University, Hopkins Marine Station, Somero Lab

Rotating Graduate Student 1/04 – 7/04

Question: What microarray protocols for target amplification are best suited to novel array applications?

Approach: I learned microarray techniques on PCR-product expression arrays that target the ecophysiology of gobies, in order to adapt these techniques to the creation of a marine microbial microarray platform.

Findings: Linear Klenow-based amplification and labelling of targeted DNA is a robust method but may not allow sufficient amplification from small environmental samples.

Stanford University, Bohannon Lab

Rotating Graduate Student 1/03 – 12/03

Question: How does simulated global change effect grassland microbial communities?

Approach: We examined methane oxidizers at the Jasper Ridge Global Change Experiment (a national Long-Term Ecological Research site), through the particulate methane mono-oxygenase gene, and by measuring of *in situ* methane

concentrations. Molecular evolutionary analyses helped map the potential functional constraints and selective pressures that gave rise to several novel clades.

Findings: Type II methanotrophs and three novel clades of potential methane-oxidizing microbes were identified at this site, whose lineages responded differently to multifactorial global change conditions. This work was published in *Applied and Environmental Microbiology*.

Univ. of Washington at Seattle's Friday Harbor Labs, Center for Cell Dynamics

Research Associate, 10/01 – 12/02

Question: How do gene networks control early pattern formation in metazoan development?

Approach: I tracked specific proteins using immunofluorescence confocal microscopy, time-lapse fluorescence microscopy of GFP-mutants, and computer-intensive image processing.

Findings: Movies and 3-D confocal stacks of segment polarity gene expression, particularly of the *engrailed* gene in *Drosophila* embryos, assisted the Center's investigations into comparative metazoan development.

Monterey Bay Aquarium Research Institute, DeLong Lab

Collaborating Scientist 9/01 – 12/01, Intern 6/01 - 8/01

Question: How does autotrophy vary with depth through the water column?

Approach: I screened the lab's large-insert environmental genomic libraries and DNA depth profiles for functional genes.

Findings: A novel monophyletic group of Form II RuBisCO was identified in the 750m Monterey Bay BAC library, representing potentially unknown autotrophy in the oxygen minimum zone. The manuscript is in preparation by the lead author.

University of Washington at Seattle's Friday Harbor Labs

Research Apprentice with Dr. Scott Edwards, 9/99 - 12/99

Question: What are the evolutionary origins of the multigene families involved in the innate immune response?

Approach: I looked for the complement component 3 gene in basal deuterostomes and protostomes, combining field and molecular biology work. DNA from twenty-six marine species across nine phyla was extracted and used for both PCR and Southern blotting.

Findings: Optimized protocols were developed for working with this extremely diverse array of source organisms.

TEACHING EXPERIENCE

University of Washington at Seattle, 1/00 – 6/02

- Lecturer and Teaching Associate, for the **Friday Harbor Lab's** "Research Apprenticeship on *Acetabularia* Morphogenesis and Development". Our apprenticeship received the best reviews of any at FHL, and we returned the following year to offer a second iteration.

- Teaching Associate and Assistant Lab Coordinator, for U.W.'s Biology 201, "Introductory Biology: Genetics and Biochemistry".
- Teaching Associate, for U.W.'s Biochemistry 442, "Cellular and Molecular Biology".

RESEARCH CRUISES

- **R/V Point Lobos**, MBARI, 6/01, 3/04, 4/04, 5/04: Microbial DNA archiving cruises.
- **R/V Western Flyer**, MBARI, 7/01: Mid-water ecology cruise led by the Robison Lab.
- **R/V Thomas G. Thompson**, Univ. of Washington, 12/00: Puget Sound Regional Synthesis Model (PRISM) cruise.

SERVICE & OUTREACH

- **Microbial Ecology Journal Club Co-Founder and -Organizer**, MIT, 09/05 – 6/07.
- **Path of Professorship Workshop Organizer**, MIT, 10/06: This goal of this two-day workshop for graduate and postdoctoral women scientists and engineers was to improve the retention of women in Academia by providing information about this career path. It was sponsored by Dean Blanche Staton (bestaton@mit.edu) and I was the sole organizer. The workshop received very positive reviews and is being repeated in 2007.
- **Earth Systems Initiative's Microbial Systems Group Mini-symposium Co-Organizer**, MIT, 06/06: The first symposium of the nascent Microbial Systems Group at MIT was designed to foster communication among labs.
- **Women-in-Science Seminar Series Co-Organizer**, MIT, 01/06 – 05/06.
- **Invited Guest Lecturer**, MBARI, 7/01 and 8/01: Lectured to visiting teachers and scientists as part of MBARI's outreach activities.

REFERENCES

Dr. Edward DeLong, Professor at the Massachusetts Institute of Technology, delong@mit.edu

Dr. George Somero, Director of Hopkins Marine Station, Stanford University, somero@stanford.edu

Dr. Brendan Bohannan, Professor, Center for Ecology and Evolution, University of Oregon at Eugene, bohannan@uoregon.edu

Dr. Garrett Odell, Director of the Center for Cell Dynamics, Friday Harbor Labs, University of Washington at Seattle, odellgm@u.washington.edu